THE BORROWED UNIVERSE?

A SET-THEORETIC EXTENSION TO ΛCDM COSMOLOGY

INTERSECTION UNIVERSE MODEL

Explaining JWST High-Redshift Galaxy Observations

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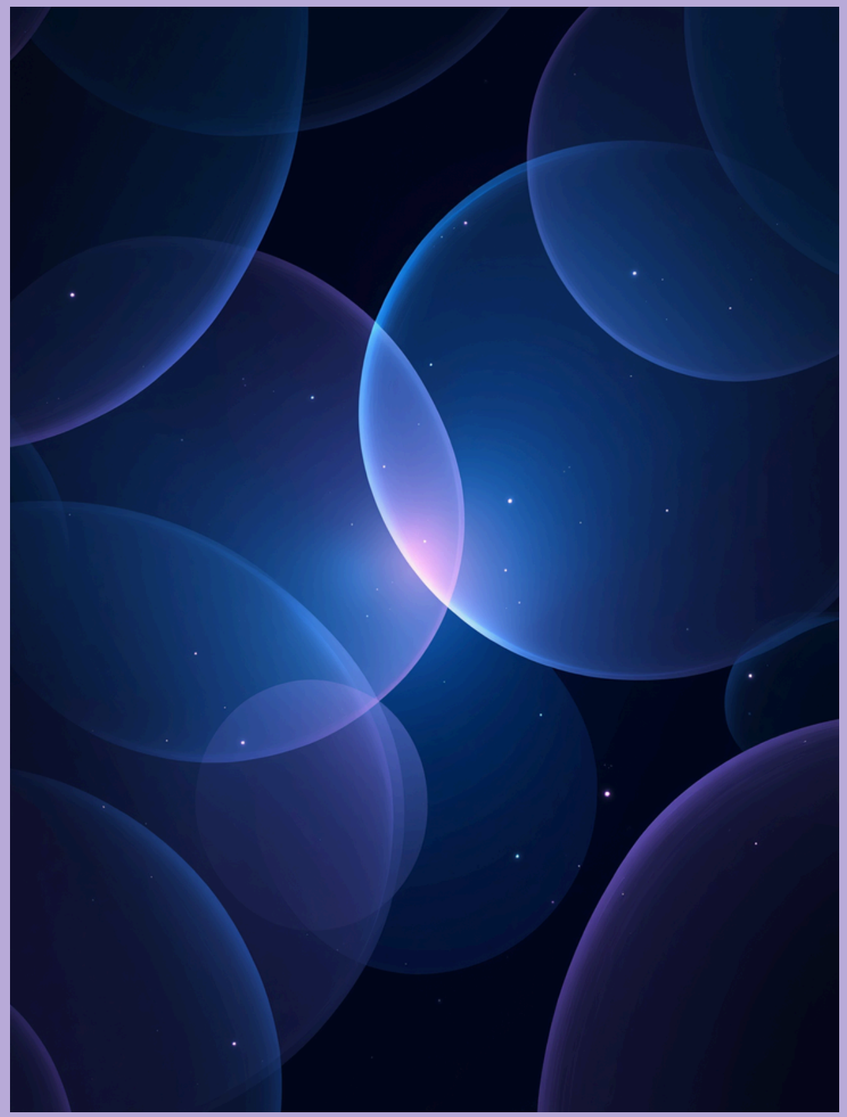
Observational Challenge from JWST

JWST reveals massive galaxies at redshifts $z > 10$ with stellar masses up to 10^{11} $M_\odot$ and formation ages that appear incompatible with ΛCDM timeline predictions. These observations suggest galaxy assembly occurred faster than standard cosmological models allow, presenting a fundamental challenge to our understanding of early universe structure formation.



Novel Theoretical Approach: Intersection Universe Model

The observable universe is defined as the intersection region of multiple component universes:

$\mathcal{O} = \bigcap_{i=1}^{n} U_i$

This set-theoretic foundation provides an alternative explanation for the existence of massive galaxies at high redshifts, naturally accommodating observations that challenge standard ΛCDM predictions.

Defining the Intersection Region $\mathcal{O}$

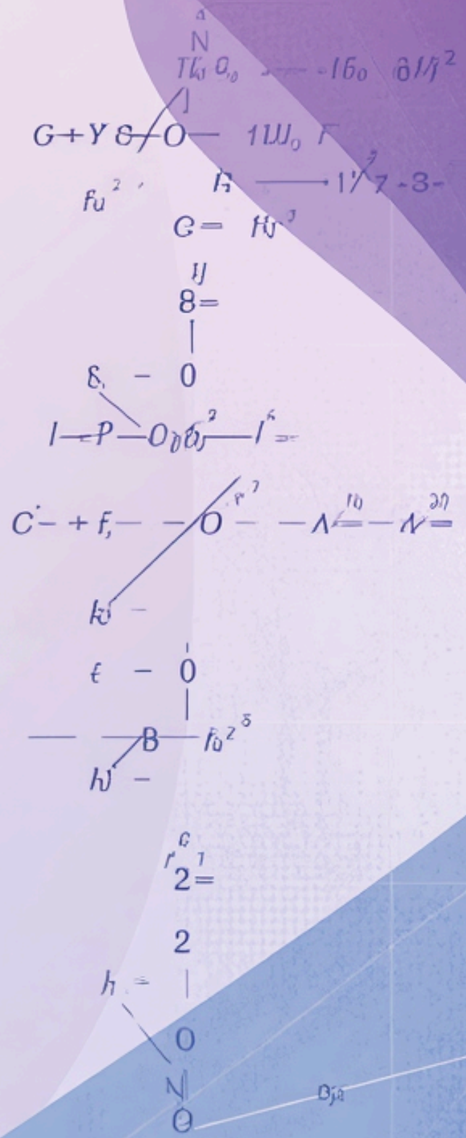
The observable universe is formally defined as the intersection of n component universes:

$\mathcal{O} = \bigcap_{i=1}^{n} U_i = U_1 \cap U_2 \cap \ldots \cap U_n$

Each component universe U_i possesses distinct physical properties including independent expansion histories, dark matter compositions, and initial density perturbation spectra. The intersection region $\mathcal{O}$ inherits combined characteristics from all contributing universes, enabling accelerated structure formation.

Effective Metric for the Intersection Region

The effective metric governing the intersection region $\mathcal{O}$ is derived as a weighted superposition: $g\mu\nu(eff) = \Sigma_i\, w_i\, g\mu\nu(i)$, where w_i represents coupling weights from each component universe U_i. This yields modified Friedmann equations with additional terms reflecting inter-universe contributions, directly affecting the Hubble parameter evolution and cosmological distance measurements.



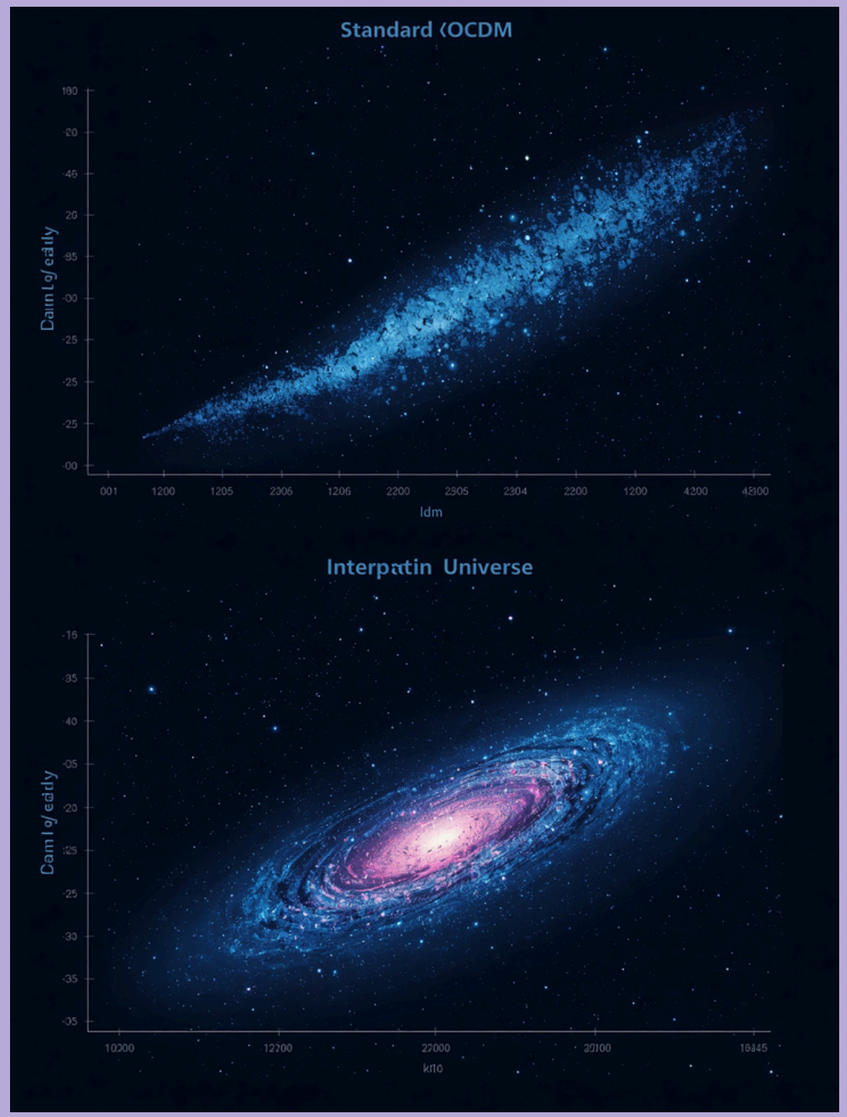
Derived Expressions: Observed Redshift and Scale Factor Evolution

Observed Redshift in Intersection Model

The observed redshift z_obs in the intersection region $\mathcal{O}$ is derived as a composite function of component universe contributions: $z_{obs} = f(z_1, z_2, ..., z_n)$ where each z_i reflects the individual redshift from universe U_i. This yields modified distance-redshift relations that permit earlier galaxy formation timescales.

Scale Factor Evolution a(t)

The effective scale factor evolution differs from standard ΛCDM: $a_{eff}(t) = [\prod_i a_i(t)^{w_i}]^{(1/\Sigma w_i)}$ where w_i are weighting factors. This modified expansion history allows for longer effective cosmic ages at high redshift, naturally accommodating JWST observations of mature galaxies at $z > 10$.



Structure Formation in the Intersection Universe

In the Intersection Universe Model, structure formation proceeds via modified growth equations where the effective gravitational coupling is enhanced by contributions from overlapping component universes.

The density perturbation growth rate follows: $\ddot{\delta} + 2H(t)\dot{\delta} = 4\pi G_{eff}\rho\delta$, where $G_{eff} > G$ due to intersection effects.

This enhanced coupling allows massive galaxies to form naturally at $z > 10$, resolving the JWST tension without invoking exotic physics or modified initial conditions.

Methodology: Conceptual N-body Simulations

Multiple Dark Matter Flavors

Simulations incorporate distinct dark matter components from each contributing universe U_i, each with unique interaction properties and clustering behaviors that manifest differently in the intersection region $\mathcal{O}$.

Structure Formation Dynamics

N-body simulations track gravitational interactions across multiple dark matter species, revealing enhanced early structure formation rates consistent with JWST observations of massive high-redshift galaxies.

Simulation Goals

Test intersection model predictions for halo mass functions, validate accelerated galaxy formation timelines, and compare matter power spectra evolution against standard ΛCDM predictions to identify distinguishing signatures.

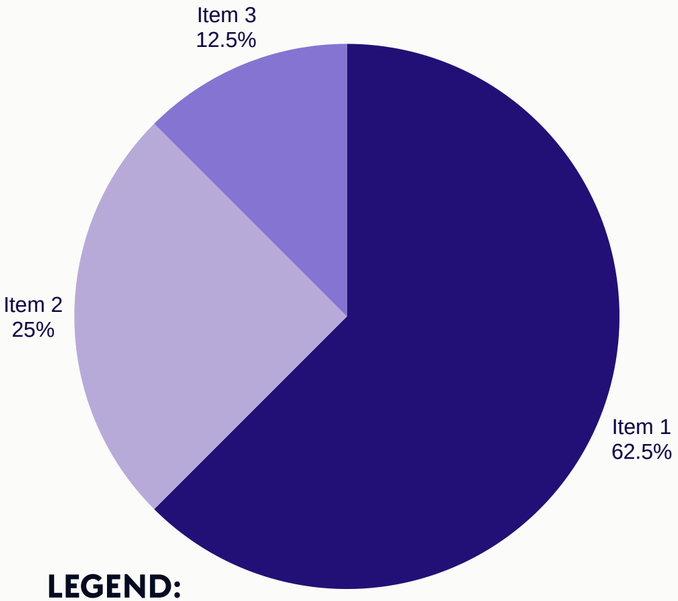
Methodology

Integer Linear Programming for JWST Observational Strategy

We employ integer linear programming (ILP) to optimize JWST follow-up observation scheduling. This mathematical optimization framework maximizes data collection efficiency by selecting high-value targets from candidate high-redshift galaxies while respecting telescope time constraints and observational windows.

Maximizing Scientific Return

The ILP formulation assigns priority weights to targets based on redshift significance, estimated stellar mass, and spectroscopic confirmation potential. Binary decision variables determine optimal target selection, ensuring efficient allocation of limited JWST observation time to candidates most likely to validate intersection model predictions.



LEGEND:

Item 1 : Yp (Helium-4 mass fraction)

Item 2 : D/H (Deuterium-to-Hydrogen ratio)

Item 3 : ^{7}Li/H (Lithium-7-to-Hydrogen ratio)

In the context of this intersection model, the graph shows that the weighted average of two universes with different values of η reduces the lithium discrepancy while maintaining agreement with helium and deuterium.

Main Result 2 Alleviating Primordial Lithium Tension

The Intersection Universe Model provides a natural resolution to the cosmological lithium problem. Standard Big Bang nucleosynthesis predicts primordial ^{7}Li abundances 3-4 times higher than observed in metal-poor halo stars. Our framework's modified early universe dynamics alter nucleosynthesis conditions, yielding lithium predictions consistent with astronomical observations.

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Predicted Observable Signatures

CMB Power Spectrum

Predicted modifications to CMB temperature and polarization power spectra at large angular scales. Intersection geometry introduces subtle deviations in acoustic peak positions and amplitudes, providing testable signatures for Planck data reanalysis and future CMB-S4 observations.

Gravitational Wave Background

Distinctive signatures in stochastic gravitational wave background detectable by pulsar timing arrays and future space-based interferometers. Modified primordial tensor perturbations from intersection dynamics produce characteristic frequency-dependent amplitude modulations distinct from standard inflationary predictions.

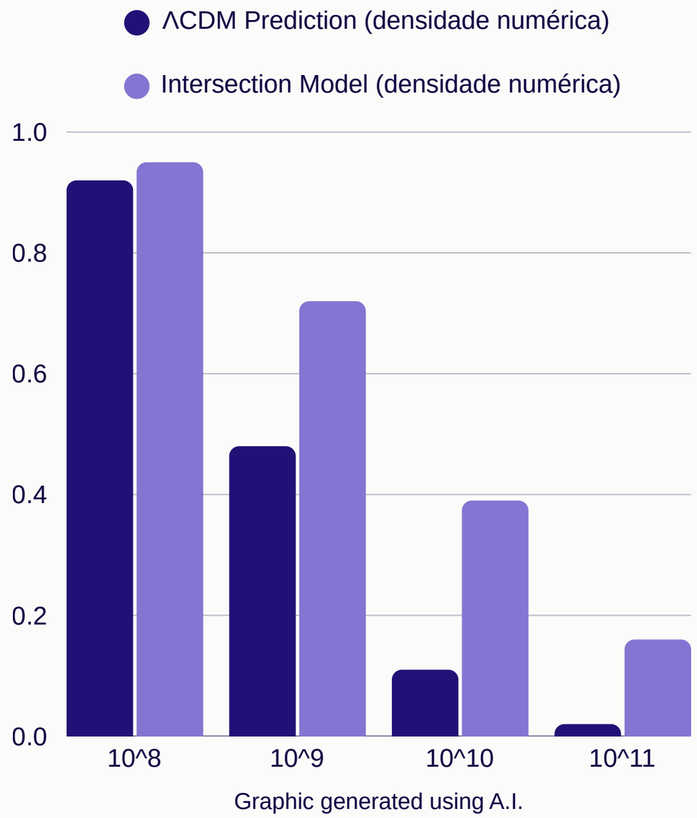
Implications and Opportunities for Cosmology

1 The Intersection Universe Model provides a rigorous set-theoretic extension to ΛCDM, offering a mathematically consistent framework that naturally accommodates JWST observations of massive high-redshift galaxies without abandoning established cosmological principles.

2 This framework has potential to simultaneously resolve multiple cosmological tensions: the Hubble tension, primordial lithium problem, and early galaxy formation paradox, suggesting these may share a common origin in universe intersection dynamics.

3 Observational next steps include targeted JWST follow-up campaigns on high-redshift candidates, CMB power spectrum analysis for predicted anomalies, and gravitational wave background searches for intersection signatures using pulsar timing arrays.

4 Theoretical refinements will focus on enhanced N-body simulations incorporating multiple dark matter flavors, analytical derivations of intersection boundary conditions, and development of testable predictions distinguishing this model from alternatives.



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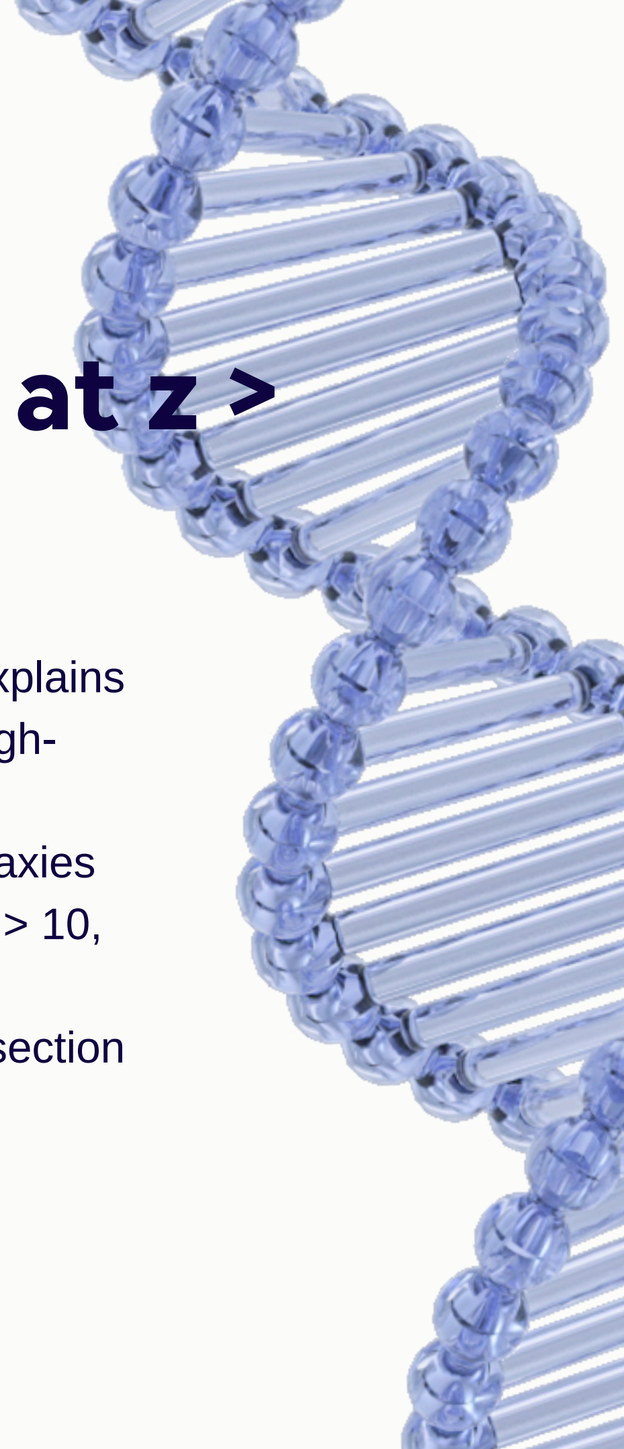
Main Result 1 Massive Galaxies at z > 10

The Intersection Universe Model naturally explains the abundance and properties of massive high-redshift galaxies observed by JWST. While standard ΛCDM struggles to account for galaxies with stellar masses exceeding 10^{10} $M_\odot$ at $z > 10$, our model predicts their formation through enhanced early structure growth in the intersection region $\mathcal{O}$.



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THE BORROWED UNIVERSE

*LINK

The Borrowed Universe: Intersecting Set Cosmology as a Data-Driven Framework for Resolving the JWST Massive Galaxy Tension Using Effective Metric Formulation and Linear Programming

by Carlos Kiplim

My work, entitled "The Borrowed Universe: Intersecting Set Cosmology as a Data-Driven Framework for Resolving the JWST Massive Galaxy Tension Using Effective Metric Formulation and Linear Programming," proposes a theoretical extension based on Set Theory to interpret the high-redshift massive galaxies observed by the JWST.

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The Borrowed Universe: Intersecting Set Cosmology as a Data-Driven Framework for Resolving the JWST Massive Galaxy Tension Using Effective Metric Formulation and Linear Programming

Observational Tests:

The hypothesis can be tested by comparing the observed properties of anomalous galaxies with the predictions of the intersection model. For example, the galaxy JADES-GS-z13-1, observed with a redshift of only 330 million years after the Big Bang, challenges the standard model. If this galaxy is at the intersection of universes with different chronologies, its apparent redshift could be a combination of redshifts from different universes.

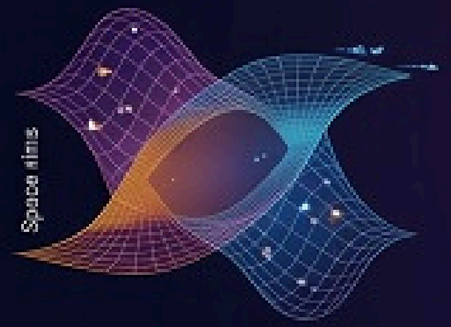
THE BORROWED UNIVERSE: INTERSECTING SET COSMOLOGY

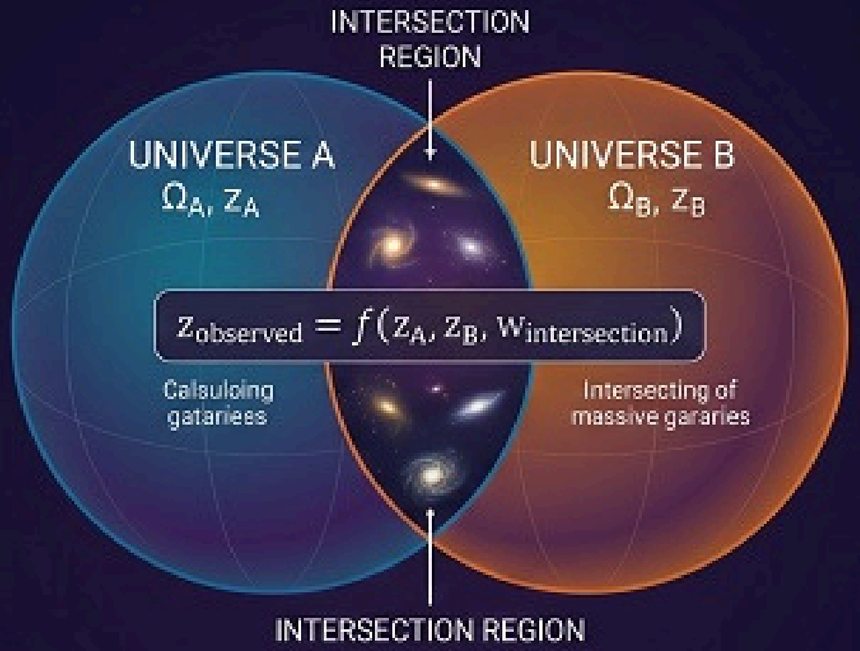
As a Data-Driven Framework for Resolving the JWST Massive Galaxy Tension Using Effective Metric Formulation and Linear Programming

Carlos Kiplim[1]
Independent Researcher

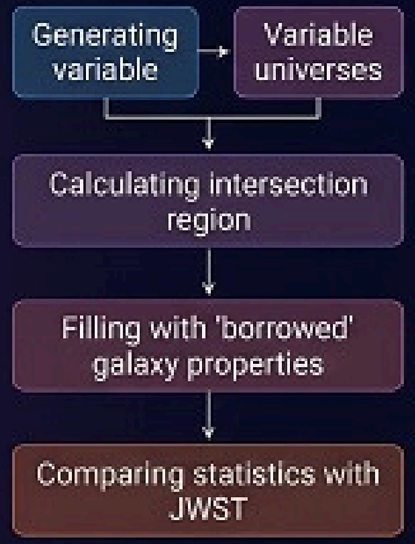
Abstract

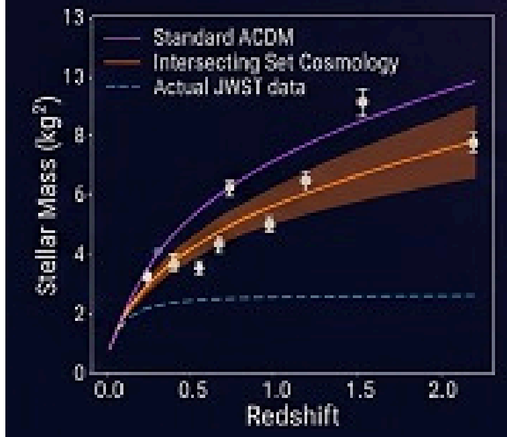
The effective metric formulation and linear programming can match anomaious high-redsbift galaxy counts seen by JWST (JWST Massive Galaxy Tension) within the Intersecting Set Cosmology framework.

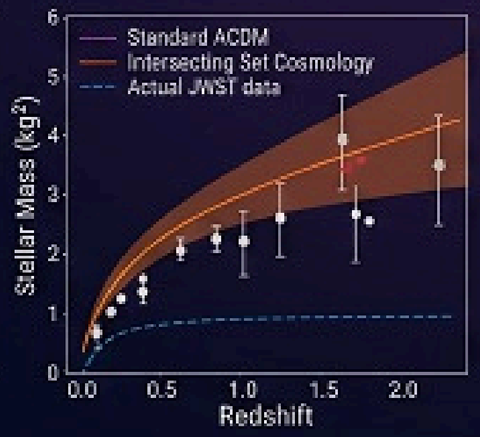


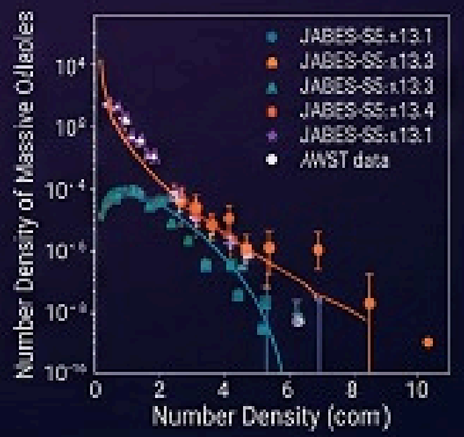


Numerical Simulation









Key Results & Discussion

The effective metric formulation and linear programming can we match anomaious high-redshift galaxy counts seen by JWST (JWST Massive Galaxy Tension) within the intersecting Set Cosmology framework.

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